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Three-phase Converter FVC series
User's manual

Release 18, November 2009

Firmware version: V1.01

This manual is an integral and essential part of the product. Read carefully and completely the warnings herein contained, they will provide important information regarding safety of operation and maintenance.

This equipment must be used only for the purpose for which has been designed. Any other utilization is improper and therefore potentially dangerous. The manufacturer is not responsible for improper, incorrect and unreasonable utilization of this equipment.

Any intervention on the equipment, that would cause a change in the structure or in the cycle of operation, must be performed or authorized by the technical department of Zenone Elettronica.

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Attention

This manual provides all the necessary information regarding the mode of operation of FVC series converters. For the correct use of this specific equipment it is recommended to refer to the characteristics data sheet of the converter, which is an integral part of this manual.

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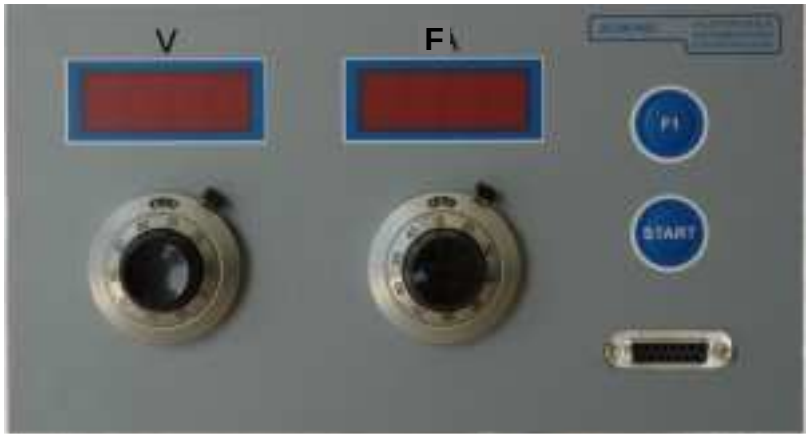
Converter series FVC

The converter FVC series are static AC/AC three-phase devices with double conversion and IGBT technology under microprocessor control. They supply the load with variable voltage and frequency at the set value regardless of impedance value and mains fluctuations.
The information about voltage and current supplied is shown by means of 7 segments displays.
They can be controlled by external signals.
They are equipped with RS485 serial interface.
They can have two output scales so to supply the maximum power at two different full-scales.

Product presentation

According to the output power, the equipment can be assembled in:
table rack
recessed rack
metal cabinet

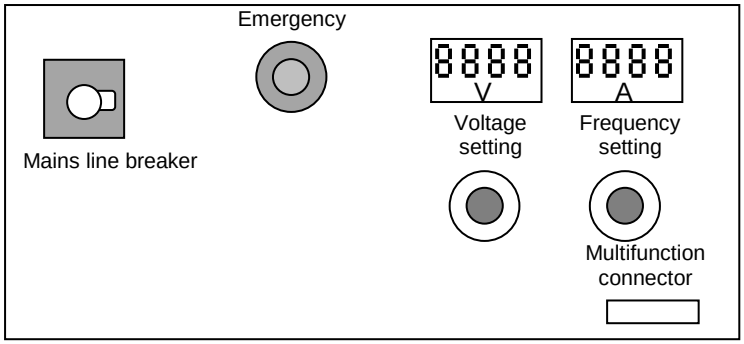
Control interface



commands and connections

voltage setting command and visualization:	on front panel
frequency setting command and visualization:	on front panel
logical command for output-on:	on front panel
selection for local/remote commands:	from RS485 serial interface
line breaker:	on front panel
RS485 serial interface:	on front panel
mains supply:	from cable on the back side (rack version) on terminal blocks inside the cabinet (metal cabinet version)
outputs:	on front panel jacks or bars (rack version) on terminal blocks inside the cabinet (metal cabinet version)
emergency input:	on front panel
auxiliary inputs/outputs	on front panel

Front panel example



Introduction

Thank you for choosing our product. We invite you to read this manual thoroughly because here you can find the technical characteristics and all the necessary information for using this equipment correctly.
The information contained in this document is subject to change without notice and it is expected to be updated exclusively for the product for which is provided.
ZENONE ELETTRONICA is not liable for technical error, printing error or omissions that might be encountered in this manual; neither is responsible for accidental or consequential damages caused by the use of its product.
This guide provides specific information related only to the mentioned products.
No part of this manual may be reproduced in any form or by any means without our written consent.
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This technical document version voids and replaces all previous versions.
The products cited in this document could be trademarks and/or registered mark of respective manufactures.

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1. Preface

1.1 *How to use and understand the instructions provided in this manual*

In this manual you can find also functions that might not be present on the equipment you have purchased; nevertheless proper information will tell you about eventual limitations.
This solution has been chosen for clarity and to better evaluate the functional characteristics available on all our products.

1.2 Safety instructions

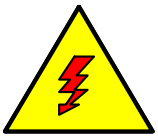
The following notes or graphic symbols list a series of instructions essential for the correct use of the equipments. Such information could be found, in graphic form, also on the equipment or used in the manual to focus the attention on the specific issue. It is highly recommended to read such instructions carefully before equipment installation.

Do not install the Equipment in environments with temperatures different from those allowed.

Do not expose the Equipment to direct sun light.

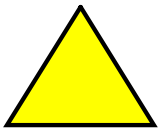
Do not pour any kind of liquids on the Equipment.
In case of fire, use foam, CO2 or dry chemicals fire-extinguishers.

Attention



The lightning symbol within a triangle is a warning symbol that indicates the presence of "dangerous voltages" inside the equipment with risk of electric shock.

The exclamation mark within a triangle is a caution symbol that indicates the presence of important additional information for the correct use of the equipment.



The empty triangle it's a caution symbol that indicates a danger of equipment damage if improperly used.

The text that follows this symbol gives information, recommendations or other particular instructions for the correct operation of the equipment.

The text that follows this symbol gives information, recommendations or other particular instructions in order to avoid danger and/or injury to personnel.

A proper disposal of the shipment packing is recommended.

1.3 Compliance declaration

CE **MANUFACTURER DECLARATION OF CONFORMITY**

The Zenone Elettronica Converter :

FVC

are herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to:

- **Electromagnetic Compatibility, Directive 2004/108/EEC**
-
- EN 61000-6-1 - CEI EN 61000-6-1 (2°ed. 2007-10) Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments "
-
- EN 61000-6-3 - CEI EN 61000-6-3 (2°ed. 2007-11)
  Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

  EN 61326-1 :2006
  Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

- **Low Voltage Equipment Directive (2006/95/EEC) and EN61010-1 ("Safety of Electrical Measuring Apparatus")**

Mirabella 01-10-2009

Zenone Eletrronica S.r.l.

Luigi Zenone

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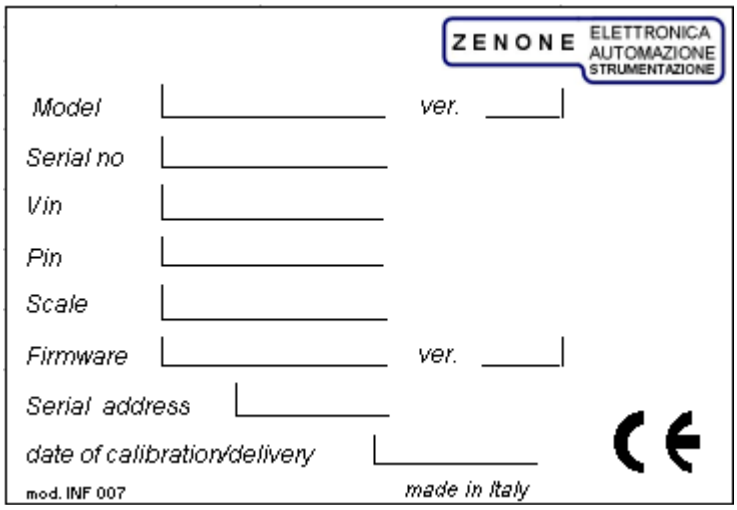
1.4 Identification label

Each equipment is identified by the following label.
We invite you to consider the data shown in it as indispensable for the product traceability, and to communicate them for eventual request for support.



2. Preliminary operations

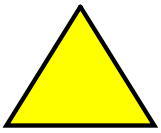
2.1 Working environment

The converter is designed for indoor use.

+ 5 °C ° + 40 °C

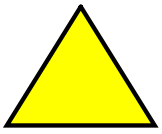
Place the device on a suitable support or on a plane surface for good stability. Be sure that proper ventilation is allowed and no objects obstruct the ventilation openings.

2.2 Precautions



Operate the equipment at its rated mains voltage, on earthed outlet only. Fasten suitable cables or bars of adequate section on the output bolts, calculated on the bases of the equipment functional characteristics.

WARNING: Power connections can generate high temperature spots, that could cause burnings.



WARNING: All standard converters are delivered with output **FLOATING**, not connected to any potential (unless otherwise specified); at the moment of installation **MUST BE CONNECTED TO GND OR TO ANY OTHER POTENTIAL**. Maximum allowed voltage on the output bolts, when not connected to earth, is 300VAC.

2.3 Equipment operation

Connect the equipment to the power mains, ***it is recommended to follow the instructions given on the equipment (or in the attached sheet) regarding voltage, frequency and earth connection,*** then turn on the power switch, which could be located on the back panel or by the cabinet side depending on the type of equipment.
In some models the power-on command can be part of an external power supply frame.
In some cases the integrated console, keyboard/display, can be connected to the cabinet by means of an external cable.
At system power-on a self-diagnostic routine tests the most important equipment functionalities and detects eventual faults.
In case of failures or malfunctions, we must be informed in advance before sending the equipment to our laboratories.

3. Auxiliary Inputs / Outputs

3.1.1 Inputs

The FVC converters have some inputs for remote control

function	Description
Emergency	Voltage-free NC contact, its opening causes the immediate disengagement of the line breaker disconnecting the equipment from the mains
on - off	Voltage-free NO contact, allows to start the converter from remote control
Voltage command	Analog input 0 ÷ 10V, remote command for the output voltage 0 ÷ 100%
Frequency command	Analog input 0 ÷ 10V, remote command for the output frequency 0 ÷ 100%

3.1.2 Outputs

The FVC converters have some outputs for remote signaling

function	description
Converter running	PNP digital output, it signals that the converter is running Max 30V 0,5A
Alarm	PNP digital output, it signals a fault Max 30V 0,5A

3.2 Communication port

The converter is equipped with a RS484 communication port which allows to connect a PC or other system for parameters setting, for the alarm register reading and for remote control.

The Baud Rate is the transfer speed and is set at 9600.

4. Converter operation

4.1 Starting the output of power

After the preliminary operations, connecting the equipment to the mains and to an eventual load, are done it's possible to turn on the converter acting on the main switch.

Note: the main switch will not activate if the emergency circuit is open or the emergency push-button is pressed.

Once the equipment is turned on it's possible to start the output of power in the following ways:

- Pressing the on-off push-button on the front panel
- With command from serial port; entering the appropriate string.
- Activating the appropriate digital input.

Under these conditions the converter will take immediately the voltage and frequency set.

4.2 Setting voltage and frequency

The setting of voltage and frequency output can be done:

- by means of the potentiometers on the front panel
- by means of analog signal 0 ÷ 10V
- from serial port

4.3 Scale selection

The FVC converters can have one or two output scales in order to supply the maximum power with different full-scales.
The scale selection must be done with the appropriate selector in stand-by mode.

An eventual change of scale, while the output is on, will take place only after the converter is switched "off"

4.3 Display of set values

In stand-by it's possible to visualize on the displays the voltage and frequency values simply pressing the "F1" push-button

"F1" pressed = visualization of voltage and frequency entered
"F1" released = off

4.4 Command type selection

The selection of the command type:

- front panel
- analog or digital inputs
- serial port

can be done via serial communication by means of "FVC Manager" software (look at paragraph 12).

4.5 Measurements display

While the output is on the converter shows on the displays the concatenated output voltage between the phases L1-L2 and the current on phase L1.
Pressing "F1" it's possible to visualize in sequence:

- FREQ = output frequency
- F1 V = voltage L1-L2
- F1 A = current L1
- F2 V = voltage L2-L3
- F2 A = current L2
- F3 V = voltage L3-L1
- F3 A = current L3

If no keys are pressed within 3 seconds the displays will show the initial condition

4.5 change of scale

The FVC converters can have two voltage scales, this allows to supply the maximum of energy even with lower output voltages.
The change of scale is done with appropriate selector on the front panel and has effect only with the equipment in stand-by.

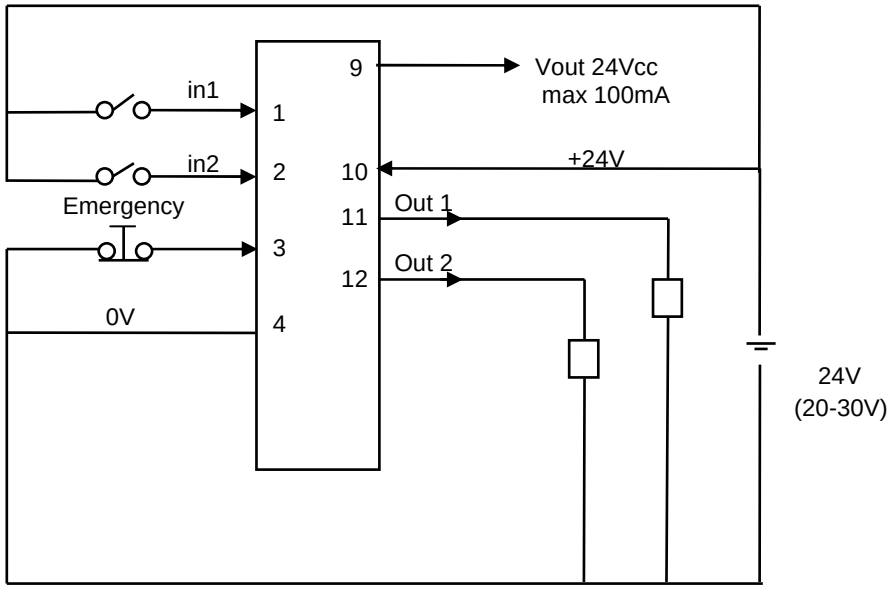
5 Maintenance instructions

- Check periodically the air vents, clean them or change the filter (if present);
- Check and tighten periodically the bolts of the connections between the power outputs and the external circuit under test (in case of high currents).

6. External connections

6.1 DB15 I/O connections

DB15 Pin Out
I/O section



Max current sink from each input: 4mA@24Vdc	Max current for each output: 500mA

I/O section

The I/O section of the interface connector is made of:

- 2 Inputs “PNP” type at 24V (Pin 1 and 2)
- 2 outputs “PNP” type at 24V (Pin 11 and 12)
- 1 “Emergency” input (pin 3)
- 1 24V supply output limited at 100 mA max
- 2 Pins assigned for a 24V supply (4=GND e 10=VCC).

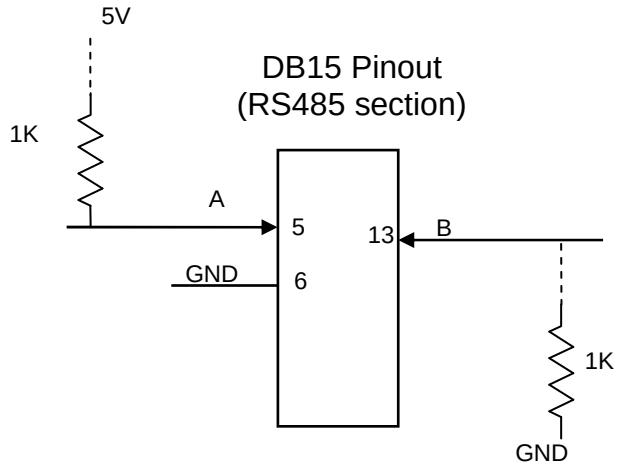
The inputs have the following function:

- Input 1: Allows to START and to STOP the output supply
- Input 2: Not used
- Input “Emergency”: normally closed to the common of 24V. When opened causes the disengagement of the line breaker.

The outputs have the following function:

- Output 1: Active when the power output is on.
- Output 2: Active in case of fault.

6.2 DB15 RS485 connection

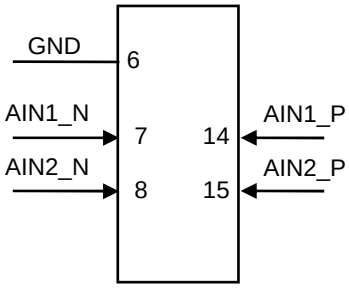


RS485 section

The RS485 section of the interface connector is made up of pin “A” and “B” of the RS485 interface and of a Ground pin. For a proper functioning of the serial communication it’s suggested to insert in a point of the line two resistances of 1Kohm connected as in the diagram.

6.3 DB15 analog connections

DB15 Pinout
(Analog section)



ANALOG section

The Analog section of the interface connector is made of pin:

- AIN1_P and AIN1_N of the Analog input 1 (Pin 14 and 7)
- AIN2_P and AIN2_N of the Analog input 2 (Pin 15 and 8)
- Reference ground GND (Pin 6)

They are two balanced inputs that can take a maximum voltage of +/- 10V with respect to GND.
Their function, when enabled by appropriate command via RS485, is to set the Voltage (Input 1) and the frequency (Input 2).

7. Error and faults signaling:

The converters are equipped with self-diagnosis routine; in case of anomalous event the power output is stopped and an error message is displayed.

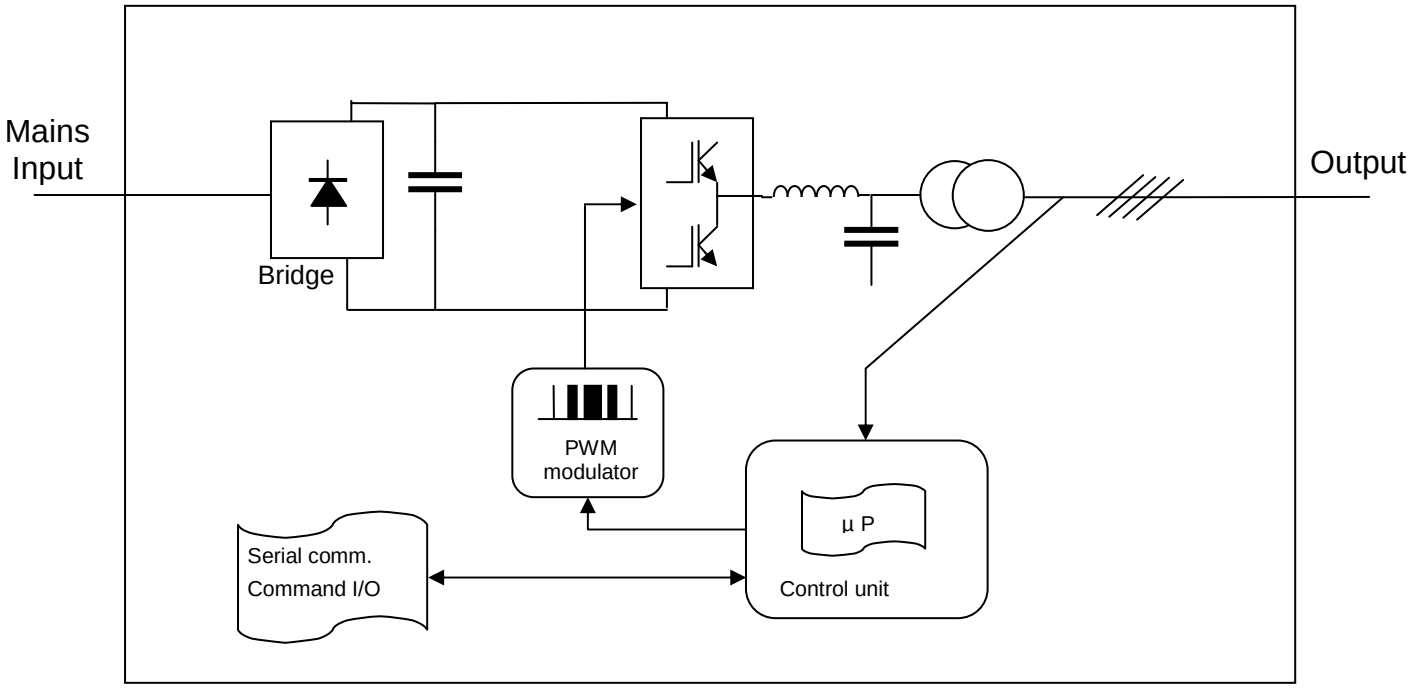
Signal	Cause	Remedy
DSP X FAIL	Communication error between the central processor and the DSP shown by nr. X	Shut off and turn on the equipment; if the error remains contact the assistance
FAIL	Generic error	Connect a PC to the equipment and by means of the software "GesPWM" check the table below

By means of the software GesPWM it's possible to visualize the following table:

Signal	Cause	Remedy
Temperature	Very high temperature of the heath-sink	Shut off the equipment and wait a few minutes. If the phenomenon repeats check the air vents and make sure the fans work properly.
Under-voltage	Supply voltage to low <350V	Check the mains and the presence of all three phases.
Over-voltage	Supply voltage to high >460V	Check the mains voltage.
Current limit	Maximum allowed current exceeded	Check the load or the parameters settings.
NTC error	Fault in the temperature measurement circuit	Contact the assistance.
Fault	IGBT failure	Contact the assistance.
Precharge	Malfunction of the precharge capacitors circuit	Check the precharge relay.

If the fault persists, contact the assistance.

8 Converter diagram



FVC basic diagram

9 Control scheme

The FVC converter has two control units, one for regulation and one for central management, both are externally accessible and modifiable through the appropriate programs:

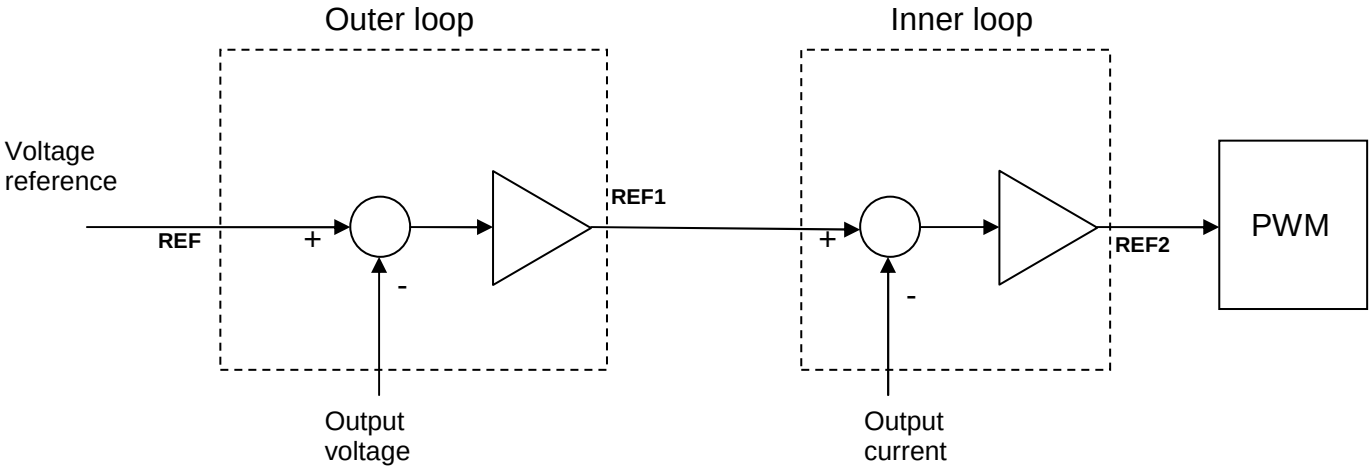
- **Control and regulation unit by means of "GesPWM" software**
- **Central management unit by means of "FVC Manager" software**

10 Control and regulation unit

The converter is equipped with a sophisticated digital control system, which has to keep the voltage and/or the current output constant regardless of load change and mains variations.
The regulation is based on two PID algorithms in sequence and named:
"Inner loop" with feedback current taken at the output,
"Outer loop" with feedback voltage taken at the output.

The following figure shows the principle of operation

10.1 Control system block diagram



The control loops are pre-adjusted in production to have a good compromise between speed and stability over most loads, in some cases it is necessary to change some parameters for the following reasons:

- Oscillations due to a load too reactive
- To enhance the generator dynamic performance
- To adapt the generator to the load

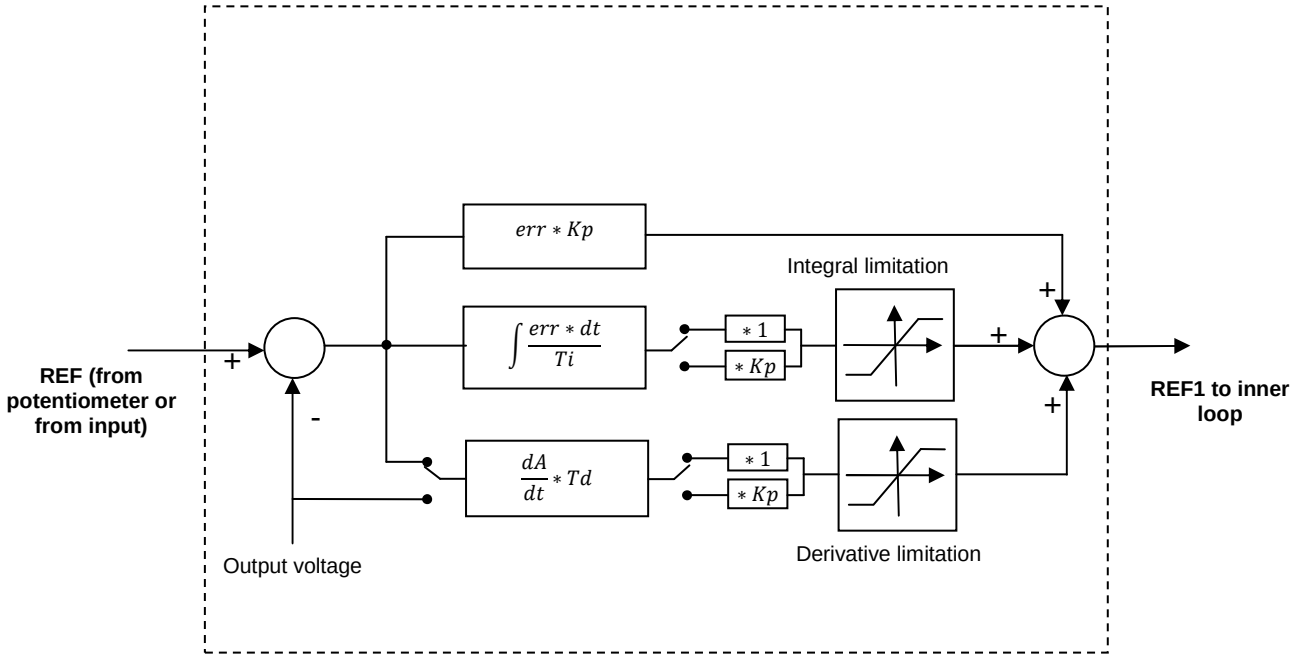
10.2 Control system description

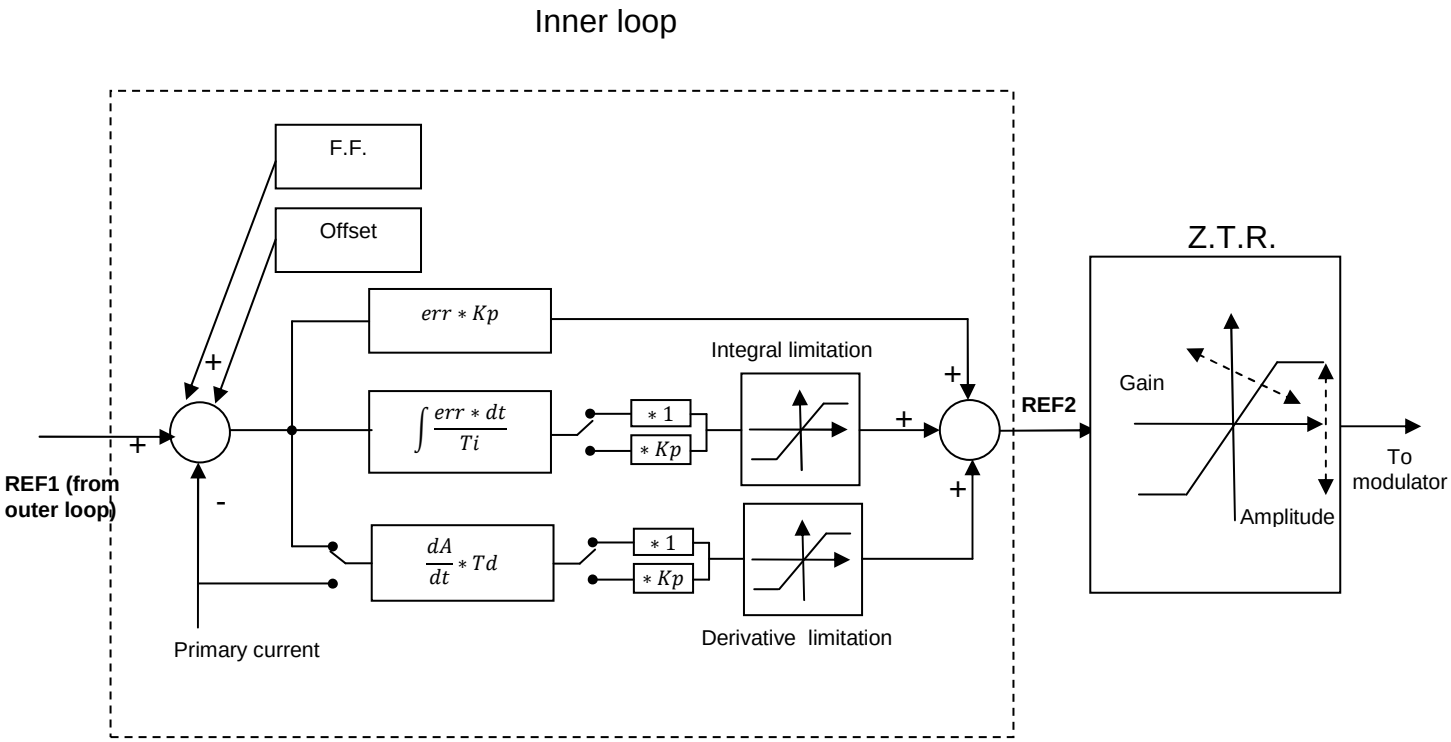
The control system is based on two PID loops in sequence, named “Inner loop and Outer loop”.

The inner loop is the fastest and will adjust the current in the load. It takes as input the reference of the outer loop

The outer loop regulates the output voltage, reacts more slowly and it provides the value of current to the inner loop. It takes as input the main reference and the feedback comes from the output voltage of the converter.

Outer loop





10.3 Parameters definition and function

Kp: **range 0 ÷ 10000**
It's the proportional gain of the regulation loop (it causes the output to change according to the input error)

Ti: **range *dt* ÷ 32000µS; 0 = integral disabled**
It's the integration time of the regulation loop in microseconds, can be applied directly or multiplied by the parameter ***Kp*** (causes the output to change with a speed proportional to the error, sets the regulation point canceling the offset).

Td: **range *dt* ÷ 32000µS; 0 = derivative disabled**
It's the derivative time of the regulation loop in microseconds, can be applied directly or multiplied by the parameter ***Kp*** (causes the output to change proportionally to the rate of change of the input, reduces the system response time).

dt **machine cycle time can not be modified.**

Positive integral limitation: range 0 ÷ 100%
It's the maximum value the integral variable can take

Negative integral limitation: range 0 ÷ 100%
It's the minimum value the integral variable can take

Positive derivative limitation: **range 0 ÷ 100%**
It's the maximum value the derivative variable can take

Negative derivative limitation: **range 0 ÷ 100%**
It's the minimum value the derivative variable can take

Z.T.R. block

The Z.T.R. block ensure the correction of the waveform during the crossing of the zero (correction of dead time) by adding an additional gain when the current crosses zero. The adjusting of this block is made with sine wave or triangular wave.

Z.T.R. gain **range 0 ÷ 100**
Represents the additional gain during the zero crossing by the current.
Z.T.R. amplitude **range 0 ÷ 100**
Represents the maximum correction value, previously calculated, that can applied to the modulator.

10.4 Procedure for adjusting the control system

The following section provides only a guideline for adjusting the PID regulation loops as in many cases does not apply a clear rule and adjustments are made based on personal experiences.

Note: Eventual parameters modifications must be done by specialized personnel only because these modifications could cause malfunctions and/or converter damages.

Note: Before making any change to the regulation parameters it's advisable to take note of the existing parameters so to restore the initial setup.

In most cases, in particular when the equipment must be adapted to the load, it's sufficient to make slight changes to some parameters following simple rules:

In case of sever capacitive load, reduce the ***Kp*** coefficients and increase the integration time ***Ti***.

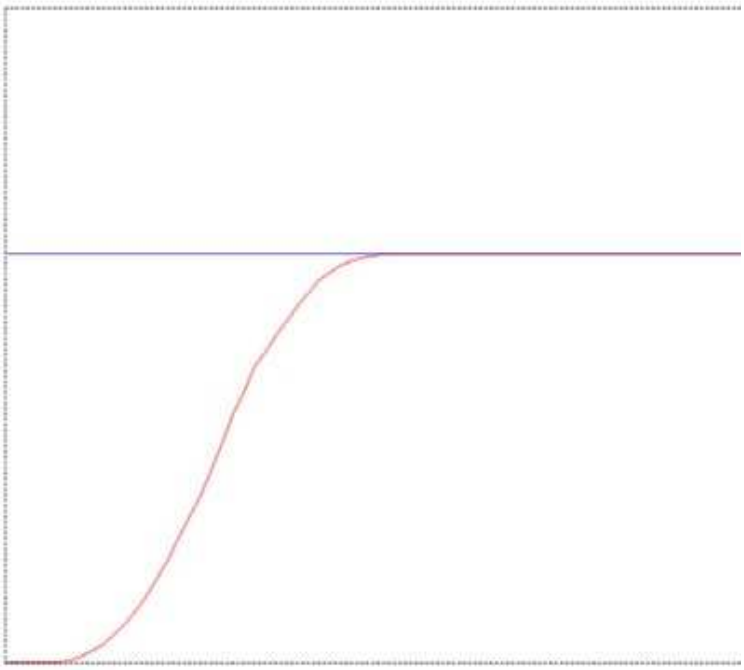
In case of sever inductive load, increase the ***Kp*** coefficients and reduce the integration time ***Ti***.

10.5 Technique for adjusting the loops

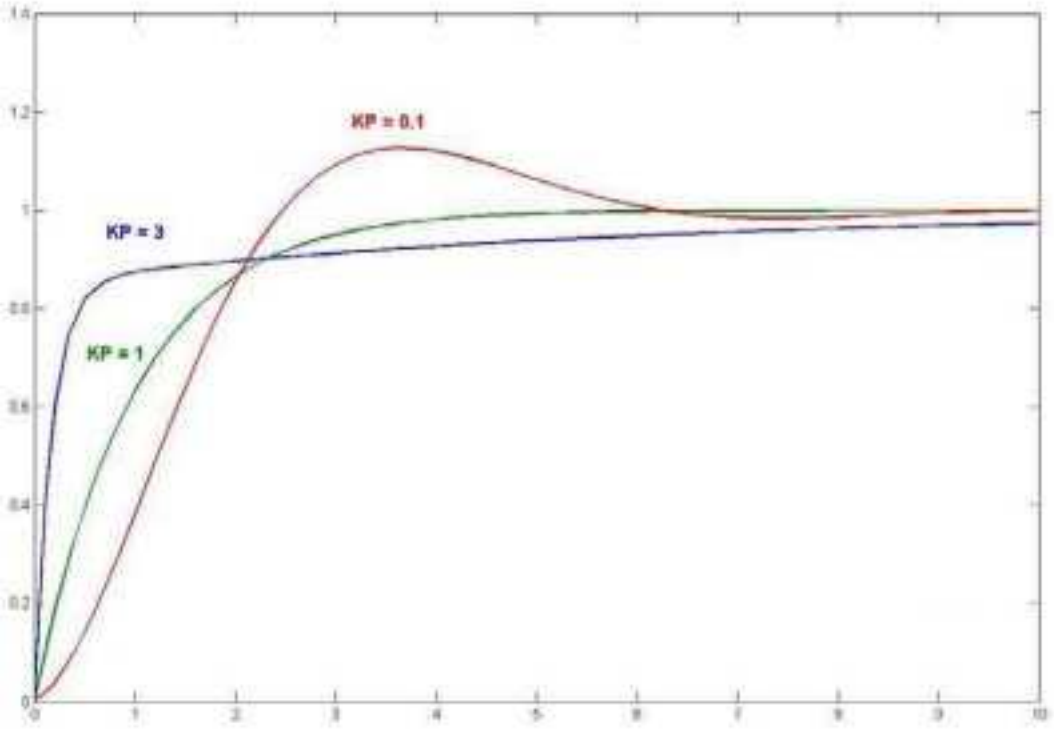
The adjusting of PID loops must be done in two phases, first the inner one and then the external one.

In order to adjust and verify the dynamic performances, it's better to have a dynamic load at the output so to visualize the voltage variations with respect to the load variations.

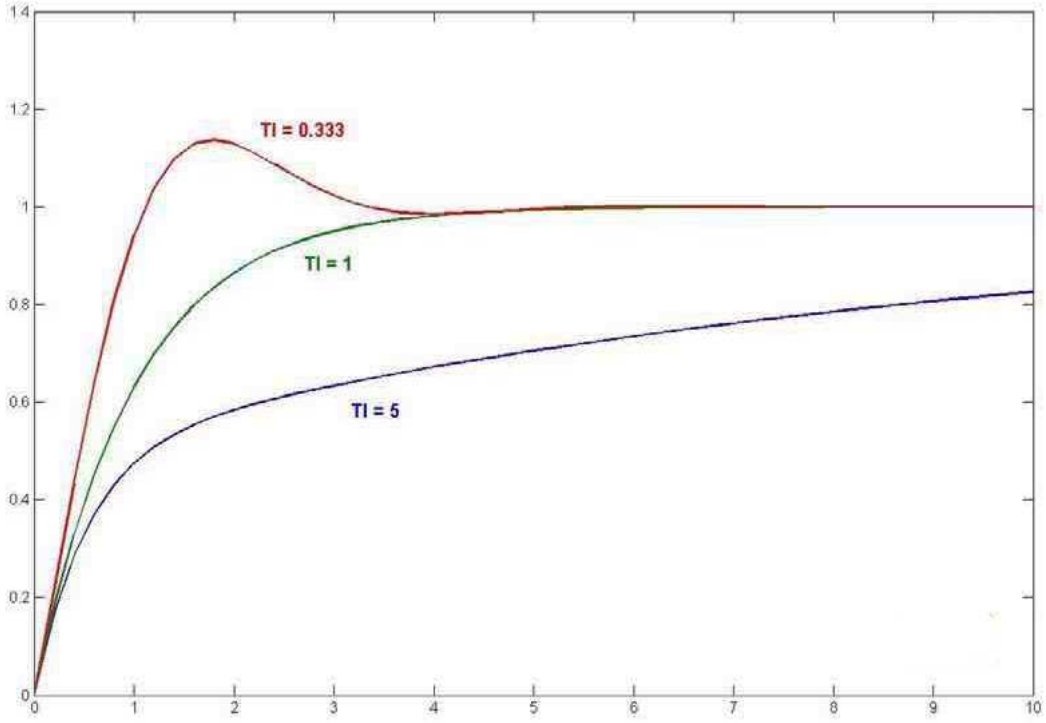
Under these conditions adjust first the inner loop ***Kp, Ti*** and ***Td*** parameters until the maximum performances are obtained.
Once the inner loop has been adjusted, the parameters ***Kp, Ti*** and ***Td*** of the external loop can be adjusted so to optimize the global performance.



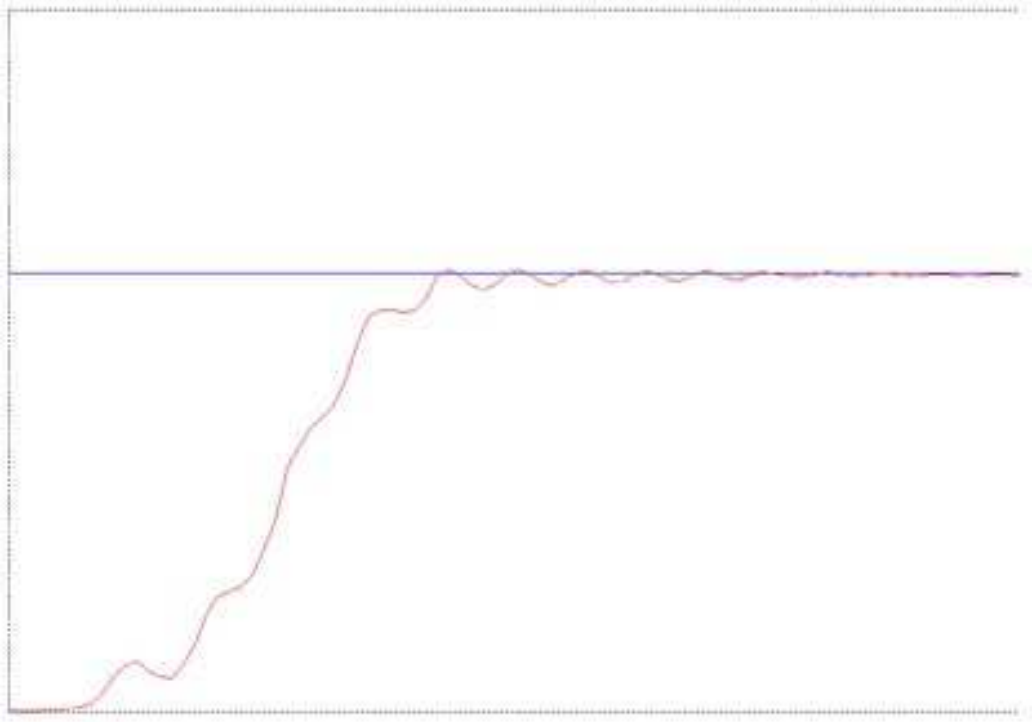
Ideal system response to a step function



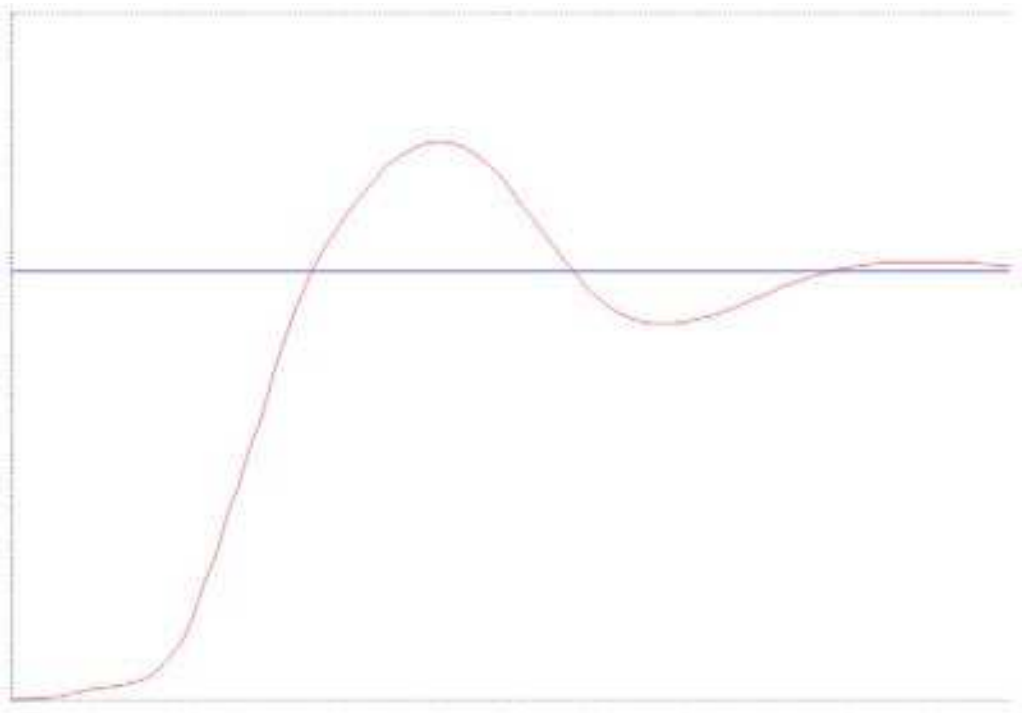
Step function response varying Kp with Ti constant



Step function response varying Ti with Kp constant



Step function response with Kp too high



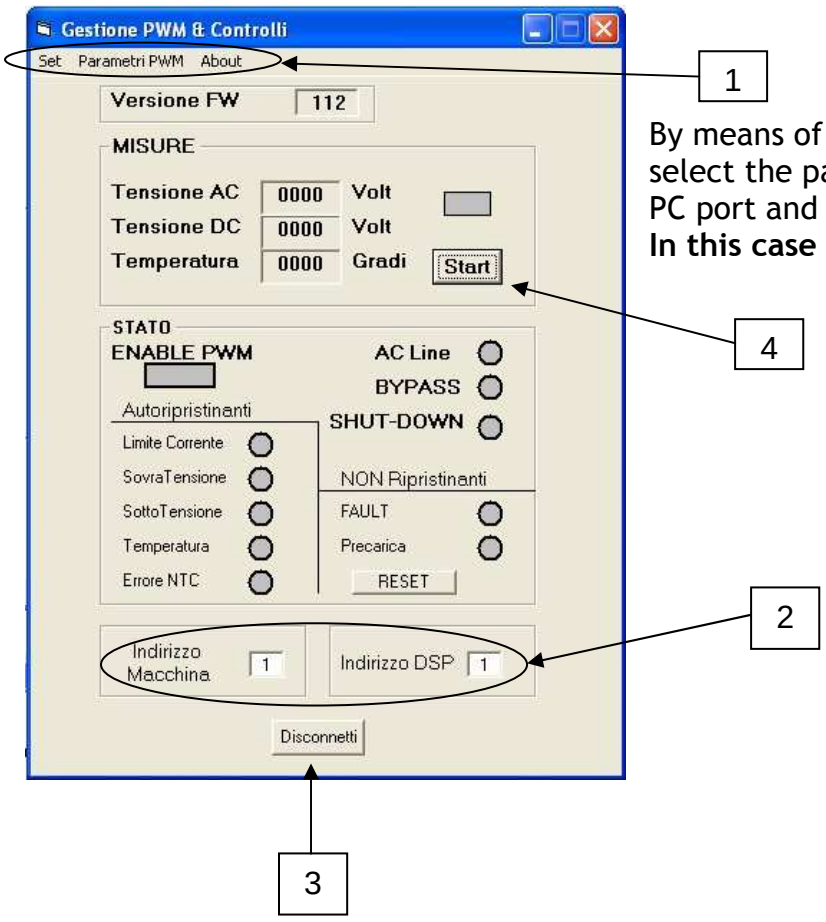
Step function response with Kp and Ti too smal

11 GesPWM software

The "GesPWM" software is compatible with WINDOWS XP systems and allows to set up some important parameters of the converter; it must be installed on a suitable PC and executed.
Such software is designed to set up the parameters of different equipment types we produce, therefore it's possible that are displayed some parameters that have no function for this specific converter.

11.1 Connecting the equipment to the PC

The converter must be connected to the PC trough the serial port of the console by means of the specific cable.
After the connection has been done and the program GesPWM is executed, the following mask will appear:



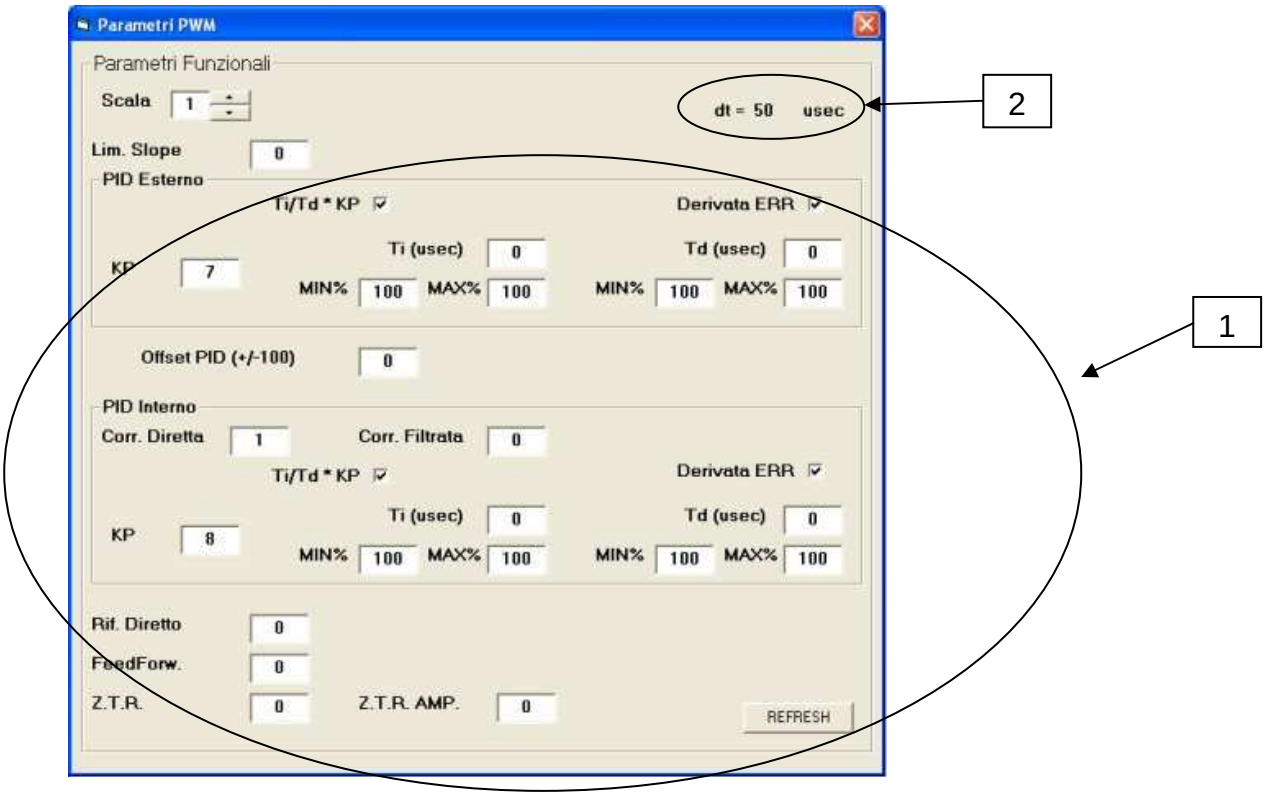
By means of the menu "Set" it's possible to select the parameters for the serial link: PC port and baud-rate.
In this case the baud-rate must be <u>9600</u>

In position "2" must be set:

- Indirizzo Macchina (machine address): Equipment serial address (**DEFAULT case 1**)
- Indirizzo DSP (DSP address): indirizzo seriale del modulo di potenza (**in this case 1)**

Once the parameters have been set-up as shown above, push the button "3" to start the connection.
In this situation the mask will appear as shown above and it's possible:

- By means of the button "4" to display the machine state with the readings of AC mains voltage, DC BUS voltage, temperature of heat sink and the state of the alarms.
  With the RESET button it's possible to reset some stored alarms.
- By means of the button "Parametri PWM" to step into the next mask where the PWM parameters are shown and could eventually be changed.



The regulation parameters for this type of equipment are those shown with "1", the others **must not be changed**.
The sampling timing "dt" is shown at point "2".
In order to change any parameter just overwrite it and push ENTER on the keyboard.
The button "REFRESH" provides an over-reading of the parameters stored in the memory module.

12 FVC Manager software

The “FVC Manager” software allows full control of FVC series voltage sources.
The “FVC Manager” can manage up to 32 FVC generators.

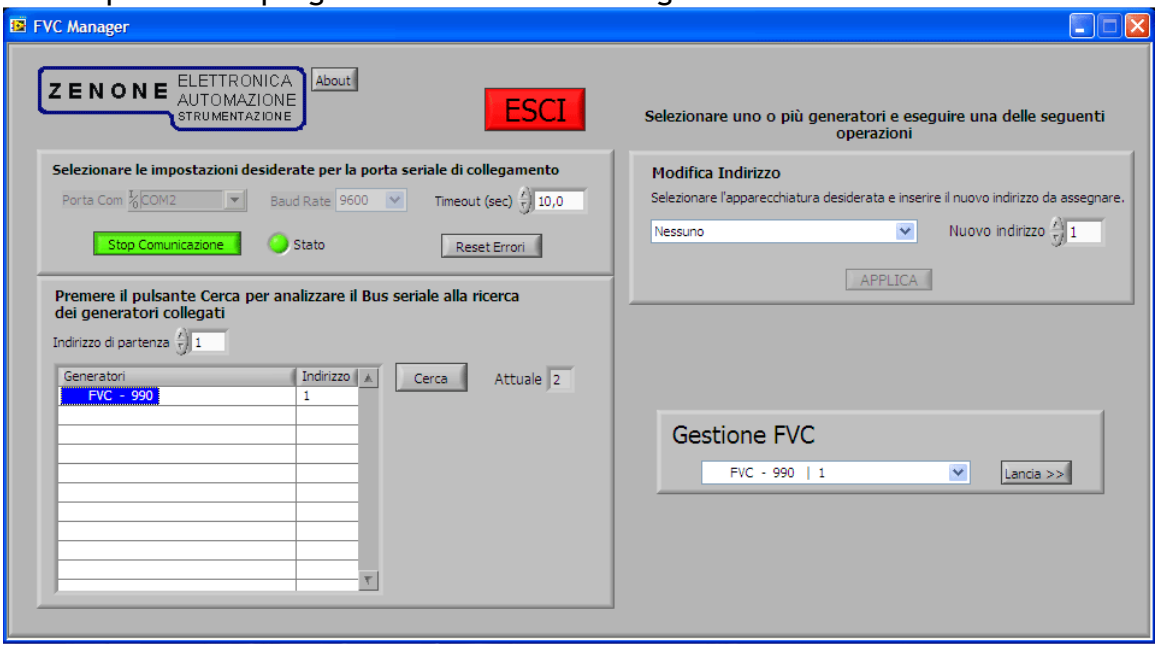
12.1 Software installation

The “FVC manager” software it’s compatible with windows XP and supplied in a compressed package.
For the installation just click over the proper icon and accept the license agreement terms.
The “FVC Manager” program is supplied with free license for the ZENONE ELETTRONICA equipments users and its disclosure it’s forbidden.

Note: ZENONE ELETTRONICA disclaims any liability for incompatibilities or conflicts with other software and operating systems.

12.2 Presentation

When opened the program shows the following mask:



12.3 Preliminary operations

The first things to do in the initial mask is to enter the “COM” number on which the converter or the converters are connected.
Click on “porta COM” and select the appropriate address, if not present click on “refresh”.
The “Baud Rate” for this equipment must be 9600.
The Timeout is the maximum waiting time for the acknowledgment by the load that a program command has been accepted. After which a serial communication error is generated.
Once these operations are finished, the serial communication can be activated pressing the proper button (the green light means activation ok); eventual communication errors can be reset with the appropriate button.

12.4 identification of FVC connected

A this point the program must identify the converters.
Write in the window at the bottom left the starting address for the search and click on “Cerca”. In this way the program will begin the identification of all converters connected and list them in the window. Once all converters are recognized it’s possible to stop the search with the button "Stop" otherwise automatically goes up to 32.

12.5 Address change

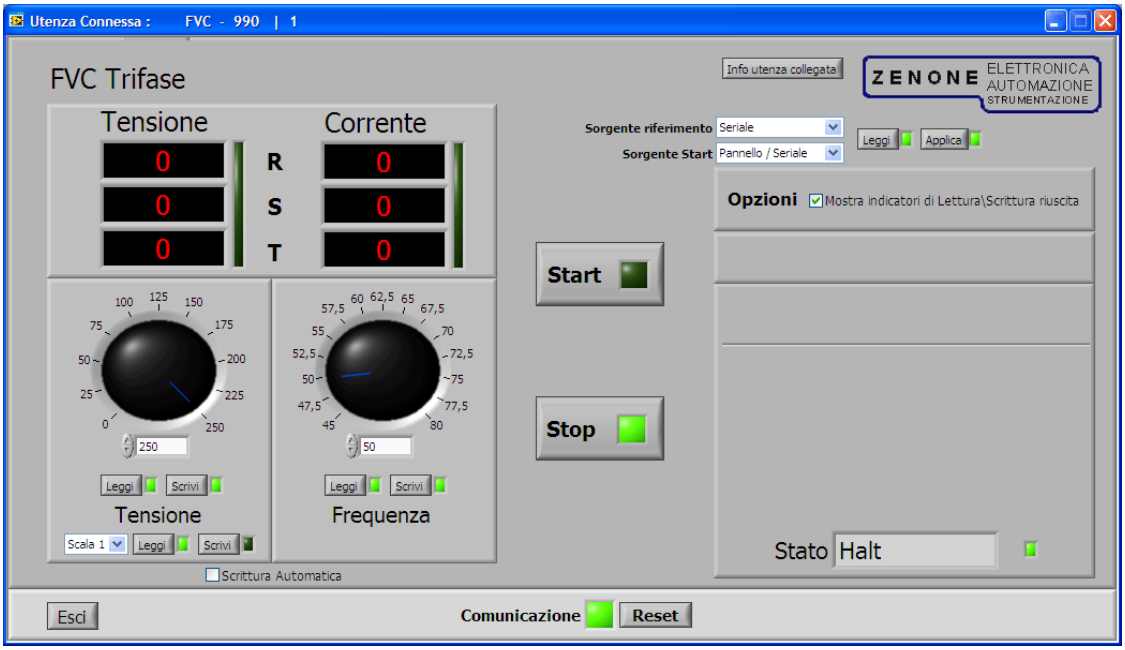
In the section at the top right it’s possible to change the address to the single converter selecting it in the window, assign the new address and click on “applica”.
Warning: do not assign the same address to more equipments.
The acquisition of the new address will take place immediately after sending the command for which the identification of the converters must be repeated.

12.6 Test applications

The program can run 32 applications of command.
To run a command application select the converter in the appropriate window and click on “lancia”.

12.7 Command mask

After selecting the converter it’s possible to run the application command. The program first reads the settings of the selected converter and then displays the mask shown below: the top row shows the name of the converter, the serial number and his serial address



Above right it is possible to set the command sources:
"Sorgente riferimento" (source reference):

- da pannello (front panel potentiometer)
- analogico (analog input 1; 0÷10V)
- seriale (serial interface)

"Sorgente Start" (Start source):

- pannello/seriale (front panel/serial interface)
- ingresso digitale (digital input)

Note: In order to control the converters with the software you need to set:
"Sorgente riferimento": seriale (serial interface)
"Sorgente Start": pannello/seriale

bottom left, you can set the FVC voltage and frequency outputs:

- With digital potentiometer.
- By entering the number expressed in% in the box under the potentiometer.
- Using increment and decrement arrows keys placed under the potentiometer.

Once the value is set click on the button "scrivi" to transfer it to the converter.
If the box "Scrittura Automatica" is selected, each modification of the reference will be automatically written in the converter.

With the Start and Stop buttons it's possible start and/or stop the supply of energy.

Under the voltage command (Tensione) it's possible to change the output scale in the appropriate box and confirming it with the command "srivi".

The displays in the top left show RMS voltages and currents on the three phases.

13 Communication protocol V1.1

It's possible to communicate with the device (send commands and get replies) by means of the RS485 serial interface, according to a half-duplex communication protocol.
The settings of the communication port is:

Device address:	from 1 to 32	(assigned with appropriate software)
Baud-rate:	9600 b/s	
Number of bits:	8	
Stop bit:	1	
Parity:	None	

Each command and each reply are preceded by a start (STX) and the address (IND) of the device we intend to communicate with, followed by a stop (ETX) and a checksum (CKSUM) for the data correctness verification.

STX	IND	Command or reply	ETX	CKSUM

STX	=	Start character, Hexadecimal value 0x02
IND	=	Device address, added to the hexadecimal value 0x80 (ex. Address 1 = character 0x81)
ETX	=	Stop character, Hexadecimal value 0x03
CKSUM	=	Control checksum, it's a character sum of all characters of the command, Inclusive of STX and ETX characters, module 256.

Each command that carries a parameter receives a reply with a result character (**ESI**) that can have the following values:

"0" = Command executed.
"1" = Command not executed.

General information commands and device options

Device serial number request

Command		Reply		
0x10	**"S"**	**0x10**	**"S"**	Serial number

Device firmware version request

Command		Reply		
0x10	**"F"**	**0x10**	**"F"**	Firmware version

Device name request

Command		Reply		
0x10	**"N"**	**0x10**	**"N"**	Device name

Request and setting device setup mode

Command		Reply		
0x10	**"M"**	**0x10**	**"M"**	Setup mode

Command			Reply		
0x11	**"M"**	Setup mode setting	**0x11**	**"M"**	**ESI**

"0"	Setup and start from panel
"1"	
"2"	
"3"	
“4”	Setup and external start

Note: In case of remote mode (look at appropriate command 0x15 “M”), this command has effect only for the start.

Commands for test main setup

Request and sending voltage value

Command

0x12	**"M"**	**IDX**

Reply if IDX ok

0x12	**"M"**	**IDX**	**UMIS**	Voltage value*

Reply if IDX not ok

0x12	**"M"**	**ESI**

Command

0x13	**"M"**	**IDX**	**UMIS**	Voltage value *

Reply

0x13	**"M"**	**ESI**

IDX	= 0x81 (Fixed value)

UMIS	= “1” (Fixed value)

* For the allowed ranges refer to equipment specifications

Request and sending frequency value

Command

0x12	**"F"**

Reply

0x12	**"F"**	Frequency in hundredths of Hz

Command

0x13	**"F"**	Frequency in hundredths of Hz

Reply

0x13	**"F"**	**ESI**

Request and sending scales

Command

0x12	**"W"**

Reply

0x12	**"W"**	Scale

Command

0x13	**"W"**	Scale

Reply

0x13	**"W"**	**ESI**

“Scala”: Can take values “1” or “2”.

Commands for reading the running test values

Reading the converter state

Command

0x14	**"E"**

Reply

0x14	**"E"**	State or result of converter

Test state:

"0"	Halt
"1"	Running
"2"	
"3"	
"4"	
"5"	
"6"	Fail (failure or malfunction)
"7"	
"A"	

Reading the actual main value

Command

0x14	**"M"**	**FA**

Reply

0x14	**"M"**	**UMIS**	Actual value

FA	Necessary in the three-phases devices. Select the phase to read ("1","2","3"), if omitted it means "1"

UMIS	
"0"	Mmillivolt
"1"	Volt

Reading the actual secondary value

Command

0x14	**"S"**	**FA**

Reply

0x14	**"S"**	**UMIS**	Actual value

FA	Necessary in the three-phases devices. Select the phase to read ("1","2","3"), if omitted it means "1"

UMIS	
"0"	Milliampere
"1"	Ampere

Reading the remote connection state

Command

0x14	**"L"**

Reply

0x14	**"L"**	Connection state

Connection state:

"L"	Not ACTIVE
"R"	Active

Test Start and Stop commands

Enables remote mode

Command

0x15	**"M"**	Mode

Reply

0x15	**"M"**	**ESI**

Remote mode:

"L"	Not active
"R"	Active

In "Remote" mode the output values are defined via SERIAL link. The start can be given from SERIAL link or from PANEL/EXTERNAL according to the appropriate command (0x11 "M").

Test start

Command

0x15	**"R"**

Reply

0x15	**"R"**	**ESI**

Note: It's possible to start the test only if in remote mode and the start from selected PANEL/EXTERNAL.
The positive result of the command means that it was accepted but, in order to be sure the start has taken place, it's necessary to read the device state (Command 14E).

Test stop

Command

0x15	**"S"**

Reply

0x15	**"S"**	**ESI**

Note: It's possible to stop the test only if in remote mode and stop from selected PANEL/EXTERNAL.
The positive result of the command means that it was accepted but, in order to be sure the stop has taken place, it's necessary to read the device state (Command 14E).

Address assignment

Command

0x15	**"A"**	IND

Reply

0x15	**"A"**	**ESI**